PREM Between FAMU and CMU

Peter N. Kalu, FAMU-FSU College of Eng., DMR-0351770

Summer Research Experience at CMU:

A major component of our PREM program is the Summer Research Experience for undergraduates at CMU. In summer 2004, a total of six FAMU PREM Undergraduate Fellows (FPUFs) spent ten weeks at CMU performing research in Materials Science. The students were assisted in their research by faculty and graduate students. At the conclusion of their research experience, they had written a paper and made two presentations to faculty and students at CMU. The details of the FPUFs and their research topics are listed below:

Velouse Pierre- Worked with Prof. Katayun Barmak on the Calorimetric Studies of the A1 to $L1_0$ transformation in FeNiPt thin films.

Ana Erb- Worked with Prof. A. D. Rollett on the Analysis of Grain Boundary Mobility in Commercially Pure Copper and Pure Nickel.

Diego Laboy- Worked with Prof. Greg Rohrer on the Lamellar Morphology of Polypropylene Copolymers Crystallized on Mica.

Ivan Lopez- Worked with Prof. Robert Suter on 3-Dimensional X-Ray Diffraction Microscopy.

Ramou Akin-Cole- Worked with Prof. Paul Salvador on Nitride Superlattice Thin Films for Superhard Coatings.

Jennifer Barrow- Worked with Prof. Michael McHenry on the Mechanical Properties of Nanocomposite Alloys.

Jennifer Barrow preparing NANOPERM $Fe_{88}Zr_7B_4Cu_1$ during the 2004 Summer Research Experience at Carnegie Mellon University

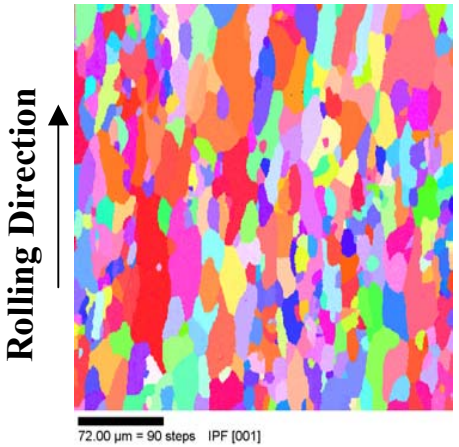
PREM Between FAMU and CMU

Peter N. Kalu, FAMU-FSU College of Eng., DMR-0351770

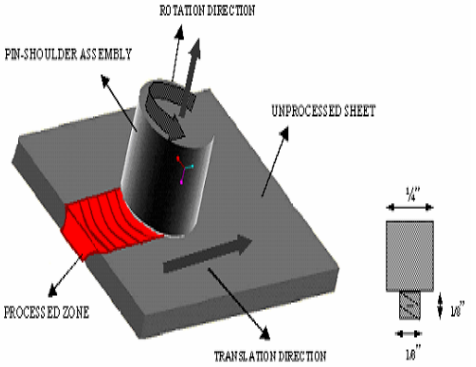
Effect of Processing Parameters on the Microstructure and Texture of Friction Stir Processed Al-5052 Alloy

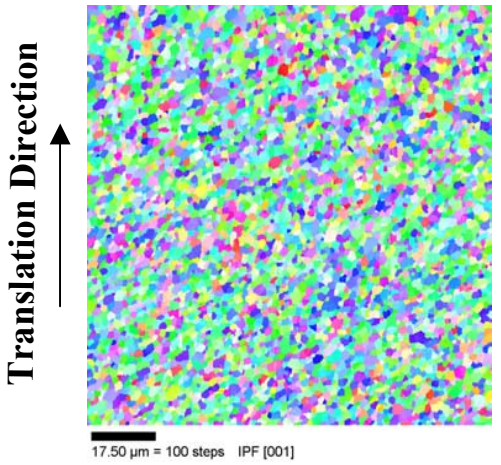
Although Friction Stir Processing (FSP) is fast becoming a formidable method for fabricating materials, little is known of the microstructural evolution associated with this technique. This research was aimed at providing a comprehensive characterization of FSP microstructure and texture using Orientation Imaging Microscopy (OIM).

Initial results show that rotational rate and translation speed have significant effect on both the grain structure and grain boundary morphology. There are efforts in our laboratory to fabricate bulk nanocrystalline materials with this technique. The figures show a dramatic reduction in grain size from 13.5µm in the as-received material to 1.5µm in FSP Al-5052 (600 rpm and 2.5"/min translation speed).



(a) As Received





(b) 600 rpm – 2.5"/min

M. Adams-Hughes, et al., In Proc. 22nd Southeastern Conference on Theoretical and Applied Mechanics (SECTAM), Tuskegee, AL

PREM Between FAMU and CMU

Peter N. Kalu, FAMU-FSU College of Eng., DMR-0351770

Education and Recruitment:

- Currently, **twelve undergraduate** and **eight graduate** students are being supported under the PREM program.
- The undergraduate students are: Jennifer Barrow, Ana Erb, Diego Laboy, Nicholas Bembridge, Linda Christian, Celina Dozier, Prince Gammage, Kevin Hutchinson, Anita Lazic, Pamela Mills, Ingrid Sarvis and Destiny Tolbert.
- The M.S. students are: Manuel Ramos (1st year), Evangelos Siannis (1st year), Huei-Hsin Chen (2nd year) and Antoine Berret (2nd year).
- The Ph.D. students are: Michelle Adams-Hughes (2nd year), Chika Okoro (2nd year), Steven Downey (1st year) and Charney Davey (1st year).

Progress Report on Students:

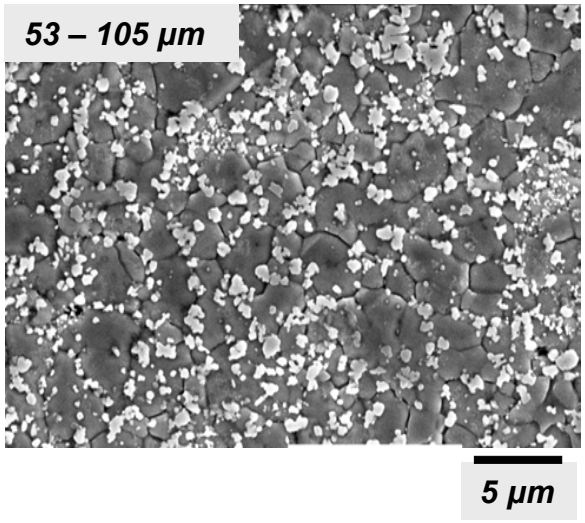
- One of our former CIRE students, **John Conn** completed his M.S. degree in Mechanical Engineering (Materials Science major) during the 2004 summer semester with funding from PREM. He has since accepted a job offer with Schlumberger.
- Michelle Adams-Hughes and Chika Okoro presented papers at **22nd Southern Conference on Theoretical and Applied Mechanics** (SECTAM XXII), Tuskegee, AL.
- Michelle Adams-Hughes and Chika Okoro are scheduled to give poster presentations at the **AFRL/ML HBCU Minority Institutions Major Trust Program Seminar -** 9/28 -9/30.
- Each of the four Ph.D. students have submitted abstracts, which have been accepted for paper presentation at the **2005 TMS ANNUAL MEETING, San Francisco, CA**.

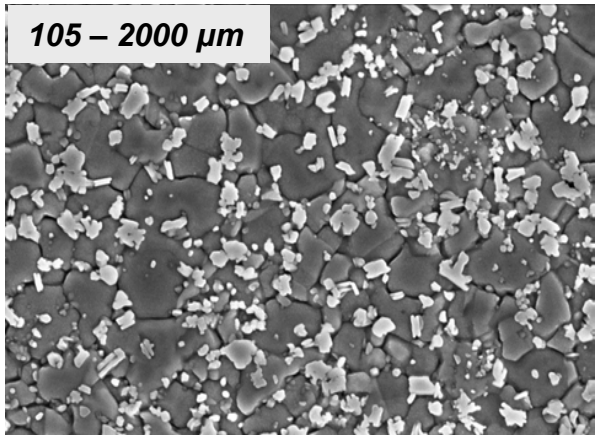
PREM Between FAMU and CMU

Peter N. Kalu, FAMU-FSU College of Eng., DMR-0351770

Effect of the Initial Powder Size on the Mechanical Properties of GRCop-84

GRCop-84 is a ternary Cu-Cr-Nb alloy with promising potentials for aerospace applications due to its excellent mechanical and thermal properties at both high and low temperatures. Rocketdyne, Pratt and Whitney and Aerojet have selected GRCop-84 for use in their next generation rocket engines. In order to optimize the properties of this material, it is important to develop a comprehensive understanding of the effect of the initial powder size on the properties. Working in conjunction with NASA, we at FAMU have found that there exists a critical powder size over which powder size does not have effect on mechanical properties.





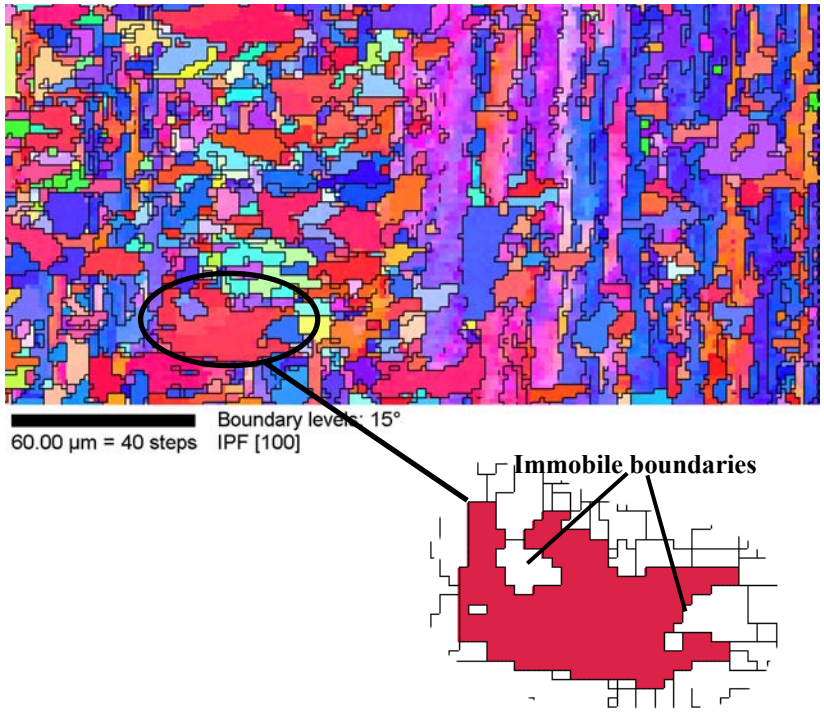
C. L. Okoro, et al., In Proc. 22nd Southeastern Conference on Theoretical and Applied Mechanics (SECTAM), Tuskegee, AL

PREM Between FAMU and CMU

Peter N. Kalu, FAMU-FSU College of Eng., DMR-0351770

The Role of Orientation Pinning in Statically Recrystallized OFHC Copper Wire

Fabrication of conductor wires for pulsed magnets usually involve low temperature annealing if re-bundling of drawn wires is employed. This research work between FAMU and CMU was aimed at providing a better understanding of the effect of low temperature annealing (170° C) on the recrystallization behavior of heavily drawn OFHC copper. Using Orientation Imaging Microscopy (OIM), it was found that the wires were partially recrystallized, and the microstructure was characterized by laterally (Type 'A') and axially (Type 'B') growing grains. The Type 'A' grains were attributed to the high frequency of the mobile boundaries with misorientations in the 40° - 50° range. Orientation pinning due to immobile boundaries, especially twin boundaries (Σ3), were found to be the main cause for the axial and lateral growth.



OIM inverse pole figure (IPF) map showing recrystallized grains parallel to drawing direction (DD). Arrow points in DD

D Waryoba, P. N. Kalu and A. D. Rollett, Metall. Mater. Trans. A, Accepted for publication, 2004